Self-assessed Impairment of Masticatory Ability and Lower Serum Albumin Levels Among Community-dwelling Elderly Persons

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SUMMARY

Background: Serum albumin is considered a key nutrient that is significantly related to general health among elderly persons. The aim of the present study was to determine the relationship between masticatory ability and serum albumin levels in the elderly.

Methods: A total of 768 persons were enrolled in the study. Data on background factors and the self-assessed masticatory ability were collected by means of questionnaires. An intraoral examination was performed to examine the pattern of occluding pairs of natural teeth, and blood samples were collected from the cutaneous vein to measure serum albumin levels. A forward stepwise multivariate logistic model was constructed with serum albumin levels as the dependent variable and the self-assessed masticatory ability as the principal independent variable, to adjust for potential confounding variables.

Results: Sex, current employment status, social interaction, and self-assessed masticatory ability were retained in the final model, and they were significantly associated with serum albumin levels. The odds ratios for lower levels of serum albumin (≤40 g/L) were 1.88 for males, 1.70 for non-working status, 1.55 for low social activity status, and 1.43 for the self-assessed impairment of masticatory ability.

Conclusion: A weak, statistically significant relationship may exist between self-assessed impairment of masticatory ability and lower levels of serum albumin in the elderly living independently. [International Journal of Gerontology 2010; 4(2): 89–95]

Key Words: elderly, mastication, nutritional status

Introduction

In Japan in 2007, the life expectancy of females was 86.0 years and that of males was 79.2 years[1]. The percentage of people aged 65 years or older in Japan reached 21.5% in 2007 and is still increasing[1]. It is important to prevent malnutrition in the elderly, because nutritional status influences general health status including functional decline, frailty, decline in quality of life, and mortality[2–4]. Therefore, it is necessary to identify the factors that influence nutritional status in elderly persons.

Serum albumin levels have been significantly related to a decline in functioning in the activities of daily living (ADL), lower extremity function, skeletal muscle mass, and mortality, especially among elderly populations[5–8]. A 12-year cohort study of elderly Japanese has shown

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that lower levels of serum albumin were significantly associated with outcomes of death or impaired ADL[5]. These findings suggest that serum albumin may be a key nutrient that is significantly related to general health status among the elderly.

Although a number of studies have reported that dental status and masticatory ability have been associated with dietary quality, nutrient intake and nutritional status[9–11], relationships between oral conditions and serum albumin levels have not been shown by any community-based large-scale study.

The self-assessed masticatory ability is not objective but is considered an approximate index that represents the total masticatory function among elderly persons with impaired dental status, and is well suited for large-scale epidemiologic studies because of its simplicity of administration[12]. The aim of this study was to determine how the self-assessed masticatory ability is related to the serum albumin level among the elderly living independently in the community.

Subjects and Methods

Study population

The study recruited 882 subjects, who were aged 65 or older, residing independently and had dental health examinations sponsored by the public offices in two rural communities (Tomamae and Iwanai) in Hokkaido, the northernmost prefecture of Japan. The examinations were performed in Tomamae over a period of 10 days in July 2004, and in Iwanai over 15 days from August to September, 2005. After exclusion of participants aged 85 or older and persons with missing data and hepatic disease, 768 subjects (87.1%) remained in the study. The reasons for exclusion of participants were that the physical abilities in most of the participants aged 85 or older had severely declined and that hepatic disease may be accompanied by hypoalbuminemia.

Data collection

Ethical approval was secured from the ethical committee of the Hokkaido University Graduate School of Dental Medicine, and written informed consent was obtained from participants. Questionnaires on background factors and self-assessed masticatory ability were sent via mail prior to the survey, and their completion was confirmed by the examiners on the day of the examination. Questions about background factors included age, sex, current employment status (working or not working), type of household (alone or with other family members), educational background (<10 years or ≥ 10 years), social interaction (yes or no) including participation in social gatherings, sports and hobbies, and chronic systemic diseases (presence or absence of one or more chronic complaints such as hypertension, cardiac complaints, diabetes, cerebrovascular complaints, respiratory tract complaints, renal complaints, articular rheumatism and hepatic diseases). The self-assessed masticatory ability was assessed by the following question, "Can you chew all kinds of food?" The answers were classified according to four alternatives, i.e., "Yes, all kinds of food" (good), "Yes, somewhat hard food" (fair), or "Only soft food" and "Only pureed food" (poor). The last two answers were taken as signifying self-assessed impairment of masticatory ability, as in the classification of Nakanishi et al[12].

The data collected by the intraoral examination included the number and the pattern of occluding pairs of natural teeth. The intraoral examination was performed by four dentists of the Graduate School of Dental Medicine, Hokkaido University, and calibration was conducted to obtain close agreement in the assessments of dental status prior to the survey. The pattern of occluding pairs of natural teeth was classified into one of the three classes based on the presence or absence of occluding pairs of natural teeth in the four support zones of the bilateral premolar and molar regions: (1) tooth contact in all four support zones; (2) tooth contact in one, two or three zones or in the frontal region only; and (3) an absence of tooth contact.

Blood samples were collected from the cutaneous vein at rest and serum albumin levels were measured by the bromocresol green method. Serum albumin levels of ≤ 40 g/L were defined as lower levels of serum albumin, because this cut-off point has been shown to be significantly associated with a decline in functioning in ADL and mortality among elderly Japanese[5].

Statistical analysis

The relationships between the incidence of lower levels of serum albumin and each of the background factors and oral conditions were analyzed. Serum albumin levels were employed as the dependent variable in a univariate unconditional logistic regression analysis, in which the self-assessed masticatory ability was employed as the principal independent variable, and the pattern of occluding pairs and background factors were

employed as potential confounding variables. The odds ratios together with the 95% confidence interval (CI) were calculated. Further, a forward stepwise multivariate logistic model was constructed to adjust for potential confounding variables. The variables that showed significant relationships with lower levels of serum albumin in the unconditional logistic regression analysis were introduced to the stepwise multivariate logistic analysis. Variables in which the probability of the stepwise analysis was <0.05 were included and those >0.10 were excluded in each step. Only p values <0.05 were considered statistically significant. The statistical analysis was performed using the SPSS 11.0 J statistical package (SPSS Japan, Tokyo, Japan) for Windows.

Results

The percentage distribution of the participants by background factors, serum albumin levels and oral conditions are shown in Table 1. Lower levels of serum albumin were found in 24.9% of the participants. The participants with self-assessed impairment of masticatory ability accounted for 41.3%. The average numbers of remaining teeth of the participants were 16.2 (age, 65–69 years), 12.6 (age, 70–74 years), 8.6 (age, 75–79 years) and 3.4 (age, 80–84 years) for females, and 17.9 (age, 65–69 years), 13.6 (age, 70–74 years), 9.4 (age, 75–79 years) and 5.9 (age, 80–84 years) for males.

Results of the univariate unconditional logistic analysis for the lower levels of serum albumin are shown in Table 2. The incidence of lower levels of serum albumin was significantly related to male sex, age 80–84 years old, non-working status, living alone, low social activity status, ≥10 years of education, and the self-assessed impairment of masticatory ability, but it was not significantly related to the type of household, systemic disease or the pattern of occluding pairs of natural teeth.

These relationships were further examined by stepwise regression analysis to adjust for confounding variables, which were significantly associated with lower levels of serum albumin in the univariate unconditional logistic analysis (Table 3). Sex, current employment status, social activity status, and the self-assessed masticatory ability were retained in the final model and significant relationships were established, but age and educational background were not retained. The odds ratios for lower levels of serum albumin were 1.88 (95% CI, 1.32–2.67; $p<0.001$) for males, 1.70 (95% CI, 1.10–2.62; $p=0.02$) for non-working status, 1.55 (95% CI, 1.09–2.20; $p=0.02$) for low social activity status, and 1.43 (95% CI, 1.01–2.03; $p=0.045$) for the self-assessed impairment of masticatory ability.

Table 1. *Characteristics of the participants (n = 768)*

General and oral variables	*n* (%)
Sex	
Female	424 (55.2)
Male	344 (44.8)
Age (yr)	
65–69	217 (28.3)
70–74	235 (30.6)
75–79	213 (27.7)
80–84	103 (13.4)
Current employment status	
Working	199 (25.9)
Not working	569 (74.1)
Household type	
Living with others	596 (77.6)
Living alone	172 (22.4)
Social interaction	
Yes	403 (52.5)
No	365 (47.5)
Educational background (yr)	
<10	571 (74.3)
≥10	197 (25.7)
Systemic disease	
Present	564 (73.4)
Absent	204 (26.6)
Serum albumin level (g/L)	
≤40	191 (24.9)
>40	577 (75.1)
Pattern of occluding pairs of natural teeth	
All four support zones	129 (16.8)
One, two or three zones or the frontal region only	226 (29.4)
Absence of occluding pairs	413 (53.8)
Self-assessed masticatory ability	
Good	451 (58.7)
Fair	254 (33.1)
Poor	63 (8.2)

Discussion

The findings here suggest that the subjective assessment of masticatory ability is significantly related to

Table 2. *Results of the univariate unconditional logistic analysis for the lower levels of serum albumin*

Independent variables	OR	95% CI	*p*
Sex			
Female	1.00 [reference]		
Male	1.33	1.22–2.00	0.001
Age (yr)			
65–69	1.00 [reference]		
70–74	1.20	0.77–1.87	0.43
75–79	1.20	0.76–1.90	0.43
80–84	2.33	1.39–3.91	0.001
Current employment status			
Working	1.00 [reference]		
Not working	1.85	1.22–2.79	0.003
Household type			
Living with others	1.00 [reference]		
Living alone	0.86	0.57–1.28	0.45
Social interaction			
Yes	1.00 [reference]		
No	1.72	1.23–2.39	0.001
Educational background			
< 10 years	1.00 [reference]		
≥ 10 years	1.47	1.02–2.13	0.04
Systemic disease			
Absent	1.00 [reference]		
Present	1.18	0.84–1.64	0.34
Pattern of occluding pairs of natural teeth			
All four support zones	1.00 [reference]		
One, two or three zones or the frontal region only	1.16	0.70–1.94	0.56
Absence of occluding pairs	1.18	0.74–1.88	0.50
Self-assessed masticatory ability			
Good	1.00 [reference]		
Fair and Poor	1.42	1.01–2.00	0.04

OR = odds ratio; CI = confidence interval.

lower levels of serum albumin among the community-dwelling elderly persons living independently. The independent relationship was confirmed after adjustment for the pattern of occluding pairs of natural teeth and demographic confounding variables, including age, sex, current employment status, the type of household, educational background, social activity status and systemic diseases.

The study population here was considered to be a representative sample of a rural elderly population in Japan, because the average number of remaining teeth here were near that of the general rural older population (17.0 [age, 65–69 years], 13.1 [age, 70–74 years], 6.5 [age, 75–79 years] and 3.2 [age, 80–84 years] for females, and 17.3 [age, 65–69 years], 14.6 [age, 70–74 years], 9.3 [age, 75–79 years] and 10.3 [age, 80–84 years] for males), in communities with populations of 50,000 or fewer inhabitants, from a 2005 national dental survey[13]. Therefore, the principal limitation was that the study population was not a nationally representative sample, and a further limitation was that the study was cross-sectional in design. Nevertheless, this is the first report of relationships between perceived masticatory ability and serum albumin levels among elderly persons, obtained from a community-based large-scale study.

Decline in nutritional status and dietary quality has been shown to be significantly related to demographic, physical and psychosocial factors, including loss of a

Table 3. *Results of stepwise multivariate logistic regression analysis for the lower levels of serum albumin*

Independent variables	OR	95% CI	*p*
Sex			
Female	1.00 [reference]		
Male	1.88	1.32–2.67	<0.001
Age	NA		
Current employment status			
Working	1.00 [reference]		
Not working	1.70	1.10–2.62	0.02
Social interaction			
Yes	1.00 [reference]		
No	1.55	1.09–2.20	0.02
Educational background	NA		
Self-assessed masticatory ability			
Good	1.00 [reference]		
Fair and poor	1.43	1.01–2.03	0.045

OR = odds ratio; CI = confidence interval. NA = not analyzed.

spouse, decline in intellectual activity, depression, lower self-efficiency, lower attitudes toward health condition, social activity status, and difficulty with meal preparation in elderly persons living independently[14–16]. The findings here suggest that working status and social activity status may contribute to dietary quality and consequently influence serum albumin levels. Otherwise, good nutritional status may contribute to functioning in ADL[5], and allow working and participation in social activities. Incidence of hypoalbuminemia has tended to be higher in males than in females among community-dwelling elderly persons in Japan[17]. The findings here also showed a sex difference in serum albumin levels, but any hypothesis proposing a mechanism for the sex difference could not be detailed here.

Dentition status, the number of teeth and the pattern of occluding pairs, has been significantly related to the stated ability to eat certain foods, dietary intake and nutritional status among elderly persons[9–11]. However, the present study shows that serum albumin levels are not statistically significantly related to dentition status, but to the subjective assessment of masticatory ability.

A number of studies have suggested poor correlations between subjective and objective assessment of masticatory ability. Significant but weak relationships were found between the ability to comminute the test food and the subjective chewing experience in edentulous subjects with complete dentures[18]. It has been suggested that the subjective assessment of masticatory ability was too optimistic when compared with the results obtained with functional chewing tests[19]. However, the self-assessed masticatory ability is considered an approximate index for representing the total masticatory function and sequential and dynamic processes in which the food is comminuted to particles, mixed with saliva, and then becomes a bolus that is suitable for swallowing[20]. Feine and Lund[21] stated in their review article that patient perception of the masticatory ability was recommended as the most appropriate for the variable of masticatory efficiency.

The serum albumin level has long been considered a significant measure of nutritional status, but it is influenced by factors other than nutritional status, including age, postural changes, inflammatory disease, vascular endothelial leaks, and diseases affecting liver function or the rate of albumin loss in the kidney[17,22–25]. Based on the findings of the present study, the self-assessed impairment of masticatory ability is thought to be independently related to serum albumin levels through nutritional status, because blood samples of all participants were collected under similar conditions, the study population did not include the elderly with any acute or severe liver diseases, and statistical adjustment for age and chronic disease was conducted.

Several studies suggest that perceived chewing ability had only a slight association with dietary intake and dietary quality[26,27]. In the present study, the relationship between the self-assessed impairment of masticatory

ability and lower levels of serum albumin only just reached statistically significant levels (odds ratio, 1.43; $p=0.045$). It is thought that dietary quality and nutritional status depend on mastication as well as additional factors, including demographic, socioeconomic, physical and psychologic factors[14–16].

Perceived chewing ability has been significantly associated with physical performance after adjustment for dentition status[28], and it has been significantly associated with 9-year mortality in a cohort of community-residing elderly persons[12]. It has been suggested that subjective assessment of masticatory ability may be a predictive factor for general health status among elderly persons[29]. The findings here support the hypothesis that self-assessed masticatory ability would be related to serum albumin levels and consequently influence general health status, that is, physical performance, functioning in ADL and mortality among elderly persons.

Identification of oral factors associated with key nutrients is an important step toward elucidating oral/systemic links among elderly persons. Intervention strategies designed to restore impaired oral conditions will be required to further elucidate the link between masticatory ability and serum albumin levels in the elderly living independently.

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